Chukchi Sea Play 20: Upper Brookian Turbidites-North Chukchi Basin

Geological Assessment

GRASP UAI: AAAAA DAU
Play Area: 6,798 square miles
Play Water Depth Range: 150-330 feet
Play Depth Range: 14,460-25,000 feet
Play Exploration Chance: 0.09

Play 20, Upper Brookian Turbidites-North Chukchi Basin, Chukchi Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas

Assessment Results as of November 2005

Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	73	292
Total Gas (Tcfg)	0.000	0.273	1.092
Total Liquids (Mmbo)	0	25	98
Free Gas** (Tcfg)	0.000	0.220	0.885
Solution Gas (Tcfg)	0.000	0.053	0.207
Oil (Mmbo)	0	13	50
Condensate (Mmbc)	0	12	48

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 20, the "Upper Brookian Turbidites-North Chukchi Basin" play, is the 24th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.3% (73 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 20 are shown in table 1. Oil and gas-condensate liquids form 34% of the hydrocarbon energy endowment of play 20. Table 5 reports the detailed assessment results by commodity for play 20.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 20. Table 4 reports the risk model used for play 20. The location of play 20 is shown in figure 1.

Potential reservoirs are mostly turbidite sandstones hypothesized to have been deposited within north-trending, faulted-bounded seafloor grabens formed during Paleocene transtensional rifting in North Chukchi basin. Play 20 is charged by the North Chukchi basin play charging system. This play was not tested by any well.

A maximum of 21 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 20. These 21 pools range in mean conditional (un-risked) recoverable volumes from 4 Mmboe (pool rank 21) to 72 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 16 Mmboe (F95) to 171 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 20.

Play 20, Upper Brookian Turbidites-North Chukchi Basin, Chukchi Sea OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	16	72	171
2	8	38	88
3	5.5	26	58
4	4.4	19	44
5	3.8	16	35
6	3.4	13	29
7	3.1	11.6	25
8	2.9	10.4	23
9	2.7	9.5	21
10	2.6	8.9	19

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

In the computer simulation for play 20 a total of 20,749 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 10 contains the largest share (5,897, or 28%) of simulation pools (conditional, technically recoverable BOE resources) for play 20. Pool size class 10 ranges from 16 to 32 Mmboe. The largest 60 simulation pools for play 20 fall within pool size class 14, which ranges in size from 256 to 512 Mmboe. Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 20.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Chukchi Sea Planning Area
Play Number: 20
Play UAI Number: AAAAA DAU

Assessor: K.W. Sherwood
Play Name: Upper Brookian Turbidites - North Chukchi Basin

Date: January 2005

Play Area: mi^2 (million acres) 6,798 (4.351)
Reservoir Thermal Maturity: % Ro 1.28 - 1.64

Play Depth Range: feet 14,460 - 25,000 (mean = 17,913)
Expected Oil Gravity: ^{o} API 35
Play Water Depth Range: feet 150 - 330 (mean = 170)

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input*	861		1143		3424	4940/5135			10257				12942
Prospect Area (acres)-Model Output**	862	1141	1394	2078	3433	4203/2716	5671	7248	8344	9907			12939
Fill Fraction (Fraction of Area Filled)	0.09	0.18	0.19	0.22	0.25	0.26/0.05	0.29	0.31	0.33	0.35			0.60
Productive Area of Pool (acres)***	132	275	340	512	855	1072/740	1423	1852	2150	2573	2900	3200	5239
Pay Thickness (feet)	60	122	136	163	200	209/64	245	273	294	327	370	401	700

* model fit to prospect area data in *BESTFIT*
** output from *@RISK* after aggregation with fill fraction
*** from *@RISK* aggregation of probability distributions for prospect area and fill fraction

MPRO Module (Numbers of Pools)

Input Play Level Chance	0.5
Output Play Level Chance*	0.4903

Prospect Level Chance	0.18

Exploration Chance	0.09

* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
	0.5	Trap Integrity (numerous faults, many traps are down-side fault traps)	
		Chance Porosity > 10%	0.18

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	12	14	15	18	21	23.05/6.72	26	30	32	34	38	40	60
Numbers of Pools in Play						2.07/2.60	4	5	6	7	8	9	21

Zero Pools at F49.05

Minimum Number of Pools	2 (F45)	Mean Number of Pools	2.07	Maximum Number of Pools	21

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	15	27	31	39	52	60/32	71	86	99	121	160	175	421
Gas Recovery Factor (Mcfg/acre-foot)	261	476	531	633	782	856/329	998	1143	1262	1490	1650	1800	3115
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	3300	3810	3890	4020	4150	4150/238	4300	4380	4430	4510	4600	4650	5000
Condensate Yield ((bbl/Mmcfg)	13	29	33	40	50	54/19	64	72	79	90	105	120	200

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.070 σ^2 (sigma squared)= 0.858

Random Number Generator Seed= 535131

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0.34
Probability Any Pool is 100% Gas	0.43

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.23
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5

Table 3. Input data for Chukchi Sea play 20, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	20. Upper Brookian Turbidites - North Chukchi Basin
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAU
Date:	1-Jan-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***1.0000***	***1.0000***
a.	**Presence of a Quality, Effective, Mature Source Rock**			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
b.	**Effective Expulsion and Migration**			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	1.00
c.	**Preservation**			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***1.0000***	***0.1800***
a.	**Presence of reservoir facies**			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	1.00	1.00
b.	**Reservoir quality**			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.18
3.	**Trap component** (3a * 3b)	**3**	***0.5000***	***1.0000***
a.	**Presence of trap**			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	1.00
b.	**Effective seal mechanism**			
	Probability of effective seal mechanism for the trap.	3b	0.50	1.00

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)	***0.5000***	
(1 * 2 * 3) *Product of All Subjective Play Chance Factors*		
Average Conditional Prospect Chance[1]		***0.1800***
(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*		
[1] Assumes that the Play exists (where all play chance factors = 1.0)		
Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide		
Exploration Chance	***0.0900***	
(Product of Overall Play Chance and Average Conditional Prospect Chance)		

Comments: *See guidance document for explanation of the Risk Analysis Form*

2b: Chance That Porosity >10%, Based on Regional Model for Porosity vs Reservoir Thermal Maturity

Table 4. Risk model for Chukchi Sea play 20, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region

GRASP Model Version: 8.29.2005)

Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAADAU**		**Play No.**		**20**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**		**SHELF**	
Play	**Level**	**-**	**Play**		**20**	**Upper Brookian Turbidites**	
Geologist	Kirk	W.	Sherwood			**- North Chukchi Basin**	
Remarks	2005	Assessment					
Run Date & Time:		Date	19-Sep-05	Time		13:56:08	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	73,298	105,490
Oil (Mbo)	12,861	22,768
Condensate (Mbc)	11,810	19,542
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	219,890	351,890
Solution Gas (Mmcfg)	53,398	94,664

10000 (Number of Trials in Sample)

0.4903 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	0	0	0	0	0
55	0	0	0	0	0
50	0	0	0	0	0
45	29,972	6,924	4,046	78,321	28,473
40	53,918	13,327	7,160	132,380	55,505
35	76,546	17,850	10,157	199,440	73,349
30	100,430	20,046	15,070	284,410	82,652
25	126,410	23,854	19,843	365,890	98,972
20	151,900	28,132	23,455	447,350	116,420
15	182,950	27,434	31,114	584,830	114,330
10	225,590	32,831	39,693	723,730	136,510
8	249,760	36,113	44,557	800,620	149,670
6	277,360	47,079	45,292	843,590	196,050
5	292,440	49,930	48,221	885,070	206,860
4	312,200	49,906	51,849	976,050	206,630
2	373,590	50,390	67,654	1,226,700	209,440
1	429,830	61,528	73,816	1,398,200	256,770
0.1	599,310	62,885	111,650	2,123,200	264,060
0.01	734,300	131,230	102,290	2,262,300	552,120
0.001	800,070	93,355	162,520	2,656,600	401,830

Table 5. Assessment results by commodity for Chukchi Sea play 20, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 20 - U. Brookian - Tertiary Turbidites-North Chukchi Basin
UAI Key: AAAAADAU

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range		Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
3	0.125	0.25	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
4	0.25	0.5	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
5	0.5	1	7	0.033737	0.0007	0.001427		0	7	0	0	0	1	1	0	0	1	1	0.630334	0.973462	5.549800	792.828560
6	1	2	87	0.419297	0.0087	0.017741		7	74	6	1	1	1	2	1	1	1	2	1.028108	1.995281	136.804528	1.572466
7	2	4	541	2.607355	0.0541	0.110318		56	420	65	1	2	1	2	1	1	1	2	2.001293	3.996245	1696.056000	3.135039
8	4	8	1996	9.61974	0.1996	0.407015		370	1142	484	1	2	1	4	1	3	1	4	4.000067	7.993878	12204.588000	6.114523
9	8	16	4345	20.940767	0.4345	0.886011		1044	1924	1377	1	4	1	4	1	4	1	6	8.001772	15.999103	51765.304000	11.913764
10	16	32	5897	28.420647	0.5897	1.202488		1412	2014	2471	1	4	1	4	1	5	1	10	16.000936	31.998140	136132.677000	23.085074
11	32	64	4976	23.981878	0.4976	1.014682		1225	1167	2584	1	3	1	3	1	4	1	6	32.000279	63.956270	224277.911000	45.071926
12	64	128	2313	11.147525	0.2313	0.471656		498	334	1481	1	3	1	2	1	4	1	5	64.004340	127.973712	201175.035000	86.975807
13	128	256	527	2.539881	0.0527	0.107463		88	53	386	1	1	1	2	1	2	1	3	128.031834	253.018760	86482.287000	164.103012
14	256	512	60	0.289171	0.006	0.012235		6	5	49	1	1	1	1	1	1	1	1	256.188961	447.962193	19107.732000	318.462189
15	512	1024	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
16	1024	2048	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
17	2048	4096	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									0.000000	0.000000	0.000000	0.000000
		Totals	**20749**	**99.999992**	**2.0749**	**4.231036**	Above Class	0	0	0									0.000000	0.000000	0.000000	0.000000

Below Class / Above Class

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 4904

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 20, 2006 assessment.

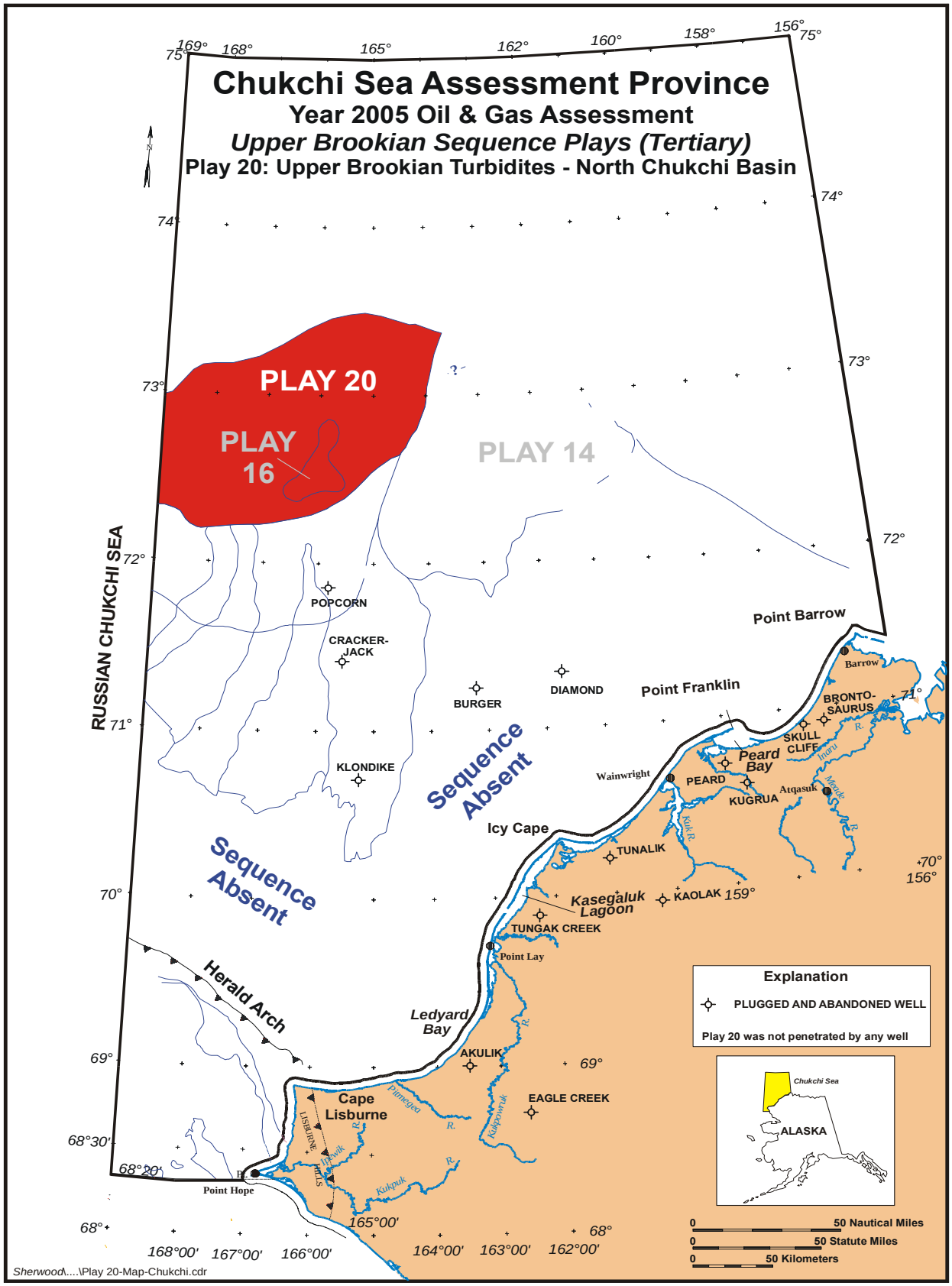

Figure 1. Map location of Chukchi Sea play 20, 2006 assessment.